COSMOGENIC RADIONUCLIDES AND TRACKS IN THE FRESH FALL PORTALES VALLEY. G. Bonino[1], G. Cini Castagnoli[1], C. Taricco[1], N. Bhandari[2] and M. Killgore[3], [1] Dipartimento di Fisica Generale, Università di Torino, Via P. Giuria 1, 10125 Torino, Italy and Istituto di Cosmogeofisica, CNR, Corso Fiume 4, 10133 Torino, e-mail: BONINO@PH.UNITO.IT, [2] Physical Research Laboratory, Ahmedabad 380 009 India, [3] Southwest Meteorite Laboratory, PO Box 95, Payson, Arizona, USA, 85547.

Fall: On 13 June 1998, at 0745 local time, a shower of meteorite fragments fell in Roosevelt County near the town of Portales in eastern New Mexico (34° 10' 12" N, 103° 17' 30" W). Eyewitnesses reported a bright fire ball in the sky followed by loud detonations. About 40 fragments with weights ranging between 50 g and 17.75 kg crashed into farmlands over an area of about 10 km x 2 km.

Measurement of the γ-Activity: One fragment weighing ~ 600 g was used for non-destructive measurement of the cosmogenic radionuclides produced in the parent meteoroid in the interplanetary space by nuclear interactions of galactic cosmic rays (GCR) with the meteoritic nuclides. This measurement, started on 3 August 1998, was performed in the underground laboratory of Monte dei Cappuccini in Torino, at 70 m of water equivalent depth. We used a highly sensitive and selective Ge-NaI(Tl) γ-spectrometer, designed and set up to measure, in particular, the very low activity of ^{44}Ti in meteorites [1]. The principal Ge detector operates in normal and in coincidence as well as in anticoincidence with the NaI detector. Twelve cosmogenic radioisotopes with half lives ranging between 16.1 days to 7.2 x 10^5 years have been measured with high precision: ^{48}V ($T_{1/2}$=16.1 d), ^{51}Cr (27.7 d), ^{7}Be (53.4 d), ^{58}Co (70.8 d), ^{56}Co (73.3 d), ^{46}Sc (83.85 d), ^{57}Co (270.02 d), ^{54}Mn (312.2 d), ^{22}Na (2.6 y), ^{60}Co (5.27 y), ^{44}Ti (59.2 y), ^{26}Al (7.2 x 10^5 y). We measured this fragment continuously for a counting live time of about 9.5 million seconds in order to obtain a suitable counting statistics of the low activity of ^{44}Ti which is useful for studying the effects of the century scale solar modulation of GCR [1, 2].

Chemical Analysis : We use the inherent ^{40}K concentration in the meteorites as an internal standard for determining the effective efficiency of counting for each meteorite fragment [3]. For this purpose, the K concentration was measured at the Joint Research Centre of E. U., Ispra - Italy in 3 different samples by Graphite Furnace-Atomic Absorption Spectrometry (GF-AAS). In order to avoid contaminations, the chemical procedure was performed in a clean room of class < 100, using ultrapure reagents, and verified by two NIST standards : SRM278 and SRM1642d. Each sample has been separated in two aliquots. Each aliquot was measured in triplicate. The average K concentration is ~ 600 ppm. Further measurements, together with those of several other elements, are in progress in order to obtain bulk composition required for estimating the isotope production rates.

Relation to Solar Activity : Solar modulation is the dominant source of the GCR variability in the inner heliosphere and consequently of the variations of the production rate of the cosmogenic radioisotopes in meteoroids. The different radionuclides in meteorites reveal the exposure history to GCR during a time interval of about two mean lives before the fall. Among a variety of radionuclides revealed in Portales Valley, the most suitable for the investigation of the heliospheric modulation of the 11 year (Schwabe) cycle are ^{22}Na and ^{54}Mn. The abundance of cosmogenic nuclides in meteorites depends on the GCR flux, but it is complicated by different parameters that influence the production rates. Among these, the most important are the target element abundances and the shape and size of meteoroids which control the attenuation of primary GCR and production and attenuation of the secondary particles. To correct for shielding effects, we have measured cosmic ray heavy nuclei tracks in two spot samples taken from different locations of the fragment. The tracks were revealed in olivine grains by boiling in WN solution for 5.5 hours. The track density in the two locations on the fragment was found to be similar, having a value of about 1.6x10^6 cm^{-2}. The exposure age of the meteorite, when available will allow us to estimate the shielding correction.

For the present, we adopt a normalization procedure which minimizes the corrections mentioned above. We consider the activity ratio ^{22}Na to the long lived ^{26}Al since these isotopes are produced in similar targets and nuclear reactions (in chondrites) and therefore the ratio is nearly independent of meteoroid composition and shielding, but it is sensitive to time variation of GCR. ^{22}Na and ^{54}Mn in Portales Valley contain the effects of the minimum of solar cycle # 22 (1986-1996) and of the early stage of increase of solar activity of cycle # 23. We compare the results obtained in Portales Valley with those of three other fresh falls Torino, Mbale [4], and Fermo [5] that were previously measured in the Monte dei Cappuccini Laboratory using similar procedure. Torino fell in 1988 roughly during similar phase of the solar cycle, at the transition from cycle # 21 to cycle # 22. Mbale fell in 1992, during the maximum of solar activity (minimum of GCR flux). Fermo fell in1996 during the final phase of solar cycle # 22. In Table 1 we report the ^{22}Na/^{26}Al ratio for the four meteorites. The value of Mbale is the average of two fragments.

Table.1 ^{22}Na/^{26}Al in meteorites fell during 1988-1998

	Torino	Mbale	Fermo	**Portales Valley**
^{22}Na/^{26}Al	1.48	1.24	1.52	1.53

These results confirm that Torino, Fermo and Portales Valley, at least in their final stage of exposure, were exposed to similar GCR fluxes. The difference respect to Mbale is evident. Results of other radioisotopes in Portales Valley are in progress.

References : [1] Bonino G. et al. (1995) *Science, 270,* 1648-1650. [2] Bonino G. et al. (1999) *Adv. Space Res.*, in press. [3] Bhandari et al. (1989) *Meteoritics, 29*, 29-34. [4] Murty et al. (1998) *Meteoritics & Planet. Sci., 32,* 1311-1316. [5] Bonino et al. (1999), in preparation.